Johnson - Space Shuttle Range Safety Panel

2005 was another busy year for the Space Shuttle Range Safety Panel. The panel was further involved in updating the Space Shuttle launch area and downrange overflight risk assessments along with the other tasks described below.

Updated Inputs for the Space Shuttle Launch Area Risk Assessment

During 2004, NASA Johnson Space Center engineers made a series of data deliveries to the 45th Space Wing to improve the inputs for the Space Shuttle launch area risk assessment. The assessment was further refined in 2005 through another series of analyses and data deliveries. One of the first improvements involved the simulation of trajectories for additional malfunction turn (off-course trajectory) failure modes that were identified using the Shuttle probabilistic risk assessment model. The trajectory data delivered in 2004 and 2005 consisted of more than 10,000 simulated failure scenarios. This analysis provided a dramatic improvement in the level of detail and accuracy for this particular aspect of the risk assessment.

Additionally, trajectory specialists worked with probabilistic risk assessment and subsystem experts to develop Shuttle first-stage, time-based failure probability distributions for use in the 45th Space Wing assessment. Supporting data and information regarding probabilistic risk assessment methodology were also provided to the 45th Space Wing. For instance, a thorough review of the failure rates for the Space Shuttle main engines was presented at the Range Safety Panel to support the selection of the time distribution for this failure mode. In addition, main engine test data was transmitted to the Space Wing so that an independent assessment of the failure probability distribution could be preformed.

Through Range Safety Panel meetings, significant steps were taken to obtain a set of inputs for launch area risk assessment that can be mutually agreed upon by NASA and the Space Wing. In a cooperative effort with the 45th Space Wing, several launch area risk assessment inputs were reinvestigated. In addition to the areas previously mentioned, updates were made to the following launch area risk assessment inputs:

- First stage destruct and chevron lines
- Failure mode allocation
- Free flying solid rocket booster modeling

The comprehensive review of launch area risk assessment inputs during 2005 raised the level of confidence in the risk estimates for STS-114 and should serve as the cornerstone for future risk assessments during the remainder of the Shuttle program.

Updated Inputs for the Space Shuttle Downrange Overflight Risk Assessment

Marked improvements were made to several areas of the Space Shuttle downrange overflight risk assessment, which analyzes the risk to the public for failures during second stage ascent. Major updates were made to the following inputs:

- Trajectory data
- External tank debris catalog
- Orbiter/payload debris catalog
- Debris survivability data
- Failure mode probability data

Several thousand trajectories were simulated for nominal ascent, malfunction turn failures, and system and environmental dispersed cases. Downrange main engine cut-off lines were updated to reflect the new malfunction turn data.

Lockheed Martin’s Michoud Assembly Facility expanded the external tank debris catalog to include pieces that were omitted in previous catalogs. The

new catalog accounts for over 90 percent of the total mass of the external tank. Likewise, the entire orbiter debris catalog was reanalyzed to reflect the data obtained from the Columbia accident recovery effort. For both the external tank and orbiter debris catalogs, a debris demise assessment was performed to determine which debris pieces would survive to ground impact. The demise assessment had never been completed for any previous Shuttle public risk assessment and added another dimension to the overall risk model.

The final improvement to the risk assessment inputs involved the estimation of failure probabilities, which were then delivered to the 45th Space Wing. The Shuttle probabilistic risk assessment model was used to estimate the failure mode probability values and corresponding time distributions. Each of the input enhancements greatly increased the level of detail and accuracy of the downrange overflight risk predictions.

Range Safety Support of STS-114

The Range Safety community successfully supported the July 2005 launch of STS-114. Numerous analyses and flight product updates were completed in time for this Return-to-Flight launch. The newly reevaluated launch area and downrange overflight risks provided updated public risk estimates to support the launch. Products for STS-300—the rescue mission for STS-114—required unique trajectory designs and were also delivered to the 45th Space Wing in the event a Shuttle rescue mission was required. Range Safety Day-of-Launch operations were checked out before the STS-114 launch and executed successfully on launch day.

Range Safety System Frequency Change

The Shuttle Program Requirements Control Board disapproved a proposed plan to change the Range Safety System frequency used by the Space Shuttle. The plan was developed in response to a National Telecommunications and Information Administration directive, but was not approved due to cost and schedule impacts. Instead, a waiver through NASA Headquarters and the National Telecommunications and Information Administration will be negotiated and the panel will track the status of the frequency through the end of the Shuttle program.

“Trunking” Radio Interference

After vehicle rollout to the pad for STS-114, there were unusual spikes in the gain control for the Shuttle Range Safety System. It was determined that a “trunking” radio system, which was not widely used before STS-107, had significantly propagated throughout KSC during the Return-to-Flight time period. The trunking radio system's handheld receivers used by KSC personnel

had a frequency band that coincided with the Range Safety System, causing potential interference. The panel investigated frequency options, but the trunking radio hardware cannot operate on a different frequency band. Measures to mitigate impacts, while maintaining all safety standards, were implemented through the panel and discussions with KSC will continue in the future. No impacts were identified to the STS-114 launch due to trunking radio interference.